Adventitious Rooting in Coastal Sage Scrub Dominants.—Adventitious rooting was discovered in *Artemisia californica* Less., *Eriogonum fasciculatum* Benth., *Salvia mellifera* Greene., and *Salvia apiana* Jeps. (voucher specimens in MACF) while collecting plant specimens for a flora of Starr Ranch, a 1600-ha Audubon Sanctuary 11 km east of San Juan Capistrano, Orange Co., CA. There is little information on the occurrence and degree of vegetative spread in common native species (Davis and Heywood, Prin. Angio. Tax. 1973). T. L. Hanes (pers. comm., 1976) indicated that adventitious rooting had not previously been reported in these species of the southern California coastal sage scrub.

A study of these species was initiated from February to October 1976, and during September 1980 to determine a) frequency of occurrence of adventitious rooting; b) environmental factors necessary for root initiation; and c) possible functions of adventitious rooting.

Observations were made by examining a minimum of 50 shrubs of each species in a variety of habitats at Starr Ranch (in the coastal foothills near the southern limit of the Santa Ana Mts.) and along Black Star Road (at the northern end of the Santa Ana Mts.). The dominant species were scored for the presence or absence of adventitious roots.

The results for three habitats are given in Table 1.

Of the four dominants, the highest average occurrence of adventitious rooting across all habitats was *E. fasiculatum* ($\bar{x}$ = 81 percent), followed by *S. mellifera* ($\bar{x}$ = 42 percent), *S. apiana* ($\bar{x}$ = 41 percent), and *A. californica* ($\bar{x}$ = 10 percent).

Both *E. fasciculatum* and *S. mellifera* produce many decumbent and vertical stems. Decumbent stems, which form the majority of adventitious roots, arise near the base of a plant and spread horizontally along the ground. Decumbent stems are often inconspicuous when covered with soil and leaf litter. Numerous vertical shoots develop along them; when the shoots are small, they may resemble seedlings.

Eriogonum fasiculatum develops numerous adventitious roots even in the most unfavorable habitats (e.g., on slopes of 80 percent gradient; on dry, south-facing slopes; and on rocky outcrops). Ten percent of the shrubs of this species sampled on level ground showed evidence of an outward circular growth pattern emanating from a single (usually dead) shrub, similar to the "clonal ring" growth of *Larrea tridentata* described by Vasek et al. (Madroño 23:1–13. 1975).

The growth habit of *S. apiana* and *A. californica* differs from *E. fasciculatum* and *S. mellifera* in that the first two species have many erect branches and few decumbent stems. Adventitious roots develop in *S. apiana* and *A. californica* mainly where the basal portions of their vertical stems are covered with soil from erosion or silt deposits. In habitats where soils are packed, there was no evidence of adventitious rooting regardless of slope aspect or amount of shade. Edaphic conditions appear to be an important factor in the formation of adventitious roots in these species.

The environmental factors necessary for the development of adventitious roots appear to be the same as those required in horticultural applications for root development in

Table 1. Percentages of Individuals of Coastal Sage Scrub Dominants with Adventitious Roots, Arrayed by Habitat. N = total number of individuals sampled in all habitats.

Species	N	Habitats			
		Slopes	Level	Riparian	Mean
Eriogonum fasciculatum	59	78	75	100	81
Salvia mellifera	72	30	20	75	42
Salvia apiana	51	40	19	80	41
Artemisia californica	98	14	8	0	10

layering, i.e., presence of humus and moisture in close contact with the stem, and elimination of light.

Adventitious rooting may serve several functions, including increasing root surface area. The rate and extent to which roots occupy soil volume is known to be critical to the survival of perennial species. In addition, avoidance of competition by stratification of root systems has been reported in a number of species and habitats (Etherington, Envir. pl. ecol. 1975). Thus, development of adventitious roots may be a means to increase water or nutrient absorption capacity. *Eriogonum fasciculatum* and *S. mellifera* should be investigated further in this regard because their growth habits suggest that their adventitious roots function to enlarge the volume from which soil resources can be absorbed.

Adventitious roots may also help to establish progeny asexually by vegetative reproduction. The growth habits of *E. fasciculatum* and *S. mellifera* suggest such asexual spread, which may be advantageous in harsh environments where seedling establishment is unlikely. However, the coastal sage dominants are all prolific seeders (Hanes, Ecol. Monogr. 41:27–52. 1971) and many seedlings are found in the wild. Additional study is needed to determine the extent of adventitious rooting and its contribution to vegetative reproduction in coastal sage dominants. Once seedlings are established, vegetative growth may give plants a competitive advantage.

Adventitious roots may also provide greater stability for a perennial shrub in a continually or periodically eroding environment. Formation of adventitious roots may be an adaptive response to edaphic conditions that enables the dominants to become reestablished when buried by erosion, as in areas of creep or flood. The geography of much of the coastal sage scrub community is characterized by steep terrain and rocky, sandy soils that are extremely unstable (Hanes, op. cit.). Many shrubs of the dominant species are buried under soil from slides or erosion, and adventitious roots form along the buried portions of their stems. Because many species of plants cannot survive suffocation if their roots are covered too deeply with soil or water (Daubenmire, Pls. Envir. 1974), the capacity to continue growth when buried by soil appears to be the most important function of adventitious rooting in the coastal sage dominants. I thank Drs. T. L. Hanes, C. E. Jones, S. Carlquist, and F. Lang for their comments on the manuscript.—R. JOHN LITTLE, Rancho Santa Ana Botanic Garden, Claremont, CA 91711. (Received 22 Feb 1980; revision received and accepted 16 Oct 1980.)

REVIEWS

Inventory of Rare and Endangered Vascular Plants of California. By JAMES PAYNE SMITH, JR., R. JANE COLE, and JOHN O. SAWYER, JR. in collaboration with W. ROBERT POWELL. viii + 115 p. California Native Plant Society Special Publication 1, Berkeley. ed. 2, 1980. $7.50. Available from CNPS, 2380 Ellsworth, Suite D, Berkeley, CA 94704.

In response to an idea from the fertile mind of its then president, G. Ledyard Stebbins, the California Native Plant Society in 1968 launched its Rare Plant Project to develop information about the rare plants of the state. At the time, intellectual curiosity rather than legal need was the main motivation. That plants had been added to the Endangered Species Act in 1973 came as a surprise to the Society some time after the fact. But by then several versions of a preliminary list had already been developed and circulated to the state's botanical community for comment, initially by Roman Gankin, and, starting in 1971, by W. Robert Powell, who contributed the enormously useful concept of the R-E-V-D coding. While federal efforts were still in developmental stages, the Society in late 1974 published the predecessor of the present edition and it immediately found wide applicability for federal agencies under the National Environmental